U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: QUALITY CONTROL FOR THE MANUFACTURE OF NON-METALLIC COMPARTMENT INTERIOR COMPONENTS

Date: 11/15/91 **Initiated by:** AIR-200

AC No: AC 21-31 **Change:**

1. PURPOSE. This advisory circular (AC) provides information and guidance concerning compliance with the requirements of Federal Aviation Regulations (FAR) Part 21, Certification Procedures for Products and Parts. The specific aspect of this AC is quality control (QC) systems for the manufacture of non-metallic compartment interior components. The Federal Aviation Administration (FAA) will consider other methods of compliance that the applicant elects to present. Non-metallic components obtain the majority of their attributes directly from their fabrication process more so than metallic components. Many QC systems established for the manufacture of metallic parts may not be adequate to provide the additional controls necessary to assure conformance to design requirements of non-metallic parts. This AC addresses those areas of a QC system that may require further expansion to adequately accommodate the manufacture of non-metallic compartment interior components.

2. RELATED FAR SECTIONS. Sections 21.135, 21.139, 21.143, 21.303, 21.605, 23.853, 25.853, 27.853, 29.853

3. RELATED REFERENCE MATERIAL.

a. AC 21-1, Production Certificates.

b. AC 21-6, Production Under Type Certificate Only.

c. AC 21-26, Quality Control for the Manufacture of Composite Structures.

d. AC 21-303.1, Certification Procedure for Products and Parts.

e. AC 25-853-1, Flammability Requirements for Aircraft Seat Cushions.

4. QUALITY CONTROL SYSTEM. A QC_z system established for the manufacture of non-metallic compartment interior components should be an integral part of and similar to any QC system established to meet the requirements of FAR Part 21. The QC system should establish and implement a plan which verifies the parameters affecting product integrity are operating under controlled conditions, and individual items, batches, or lots conform to specified quality standards. Many of the operations used to manufacture non-metallic components differ greatly from those used to manufacture metallic components. Some aspects of the QC system for non-metallic compartment interior components may need to be expanded to assure compliance to the design requirements. These aspects include, but are not limited to the following: development of nondestructive and destructive testing techniques and quality standards, in-process manufacturing controls, safety and health information, and use of process control panels or simulated parts for destructive tests.

Note: Simulated parts or process control panels should be produced with each production lot. A simulated part or a process control panel when used as a test specimen must be representative of the part throughout its manufacturing process and must be constructed from the same lot of raw materials. When possible the test specimen (production part, process control panel or simulated part) should represent an area of vulnerability with respect to flammability testing.

5. MATERIAL AND PROCESS SPECIFICATIONS. Material and process specifications used to produce non-metallic compartment interior components should contain sufficient information to ensure critical parameters in the fabrication process are identified to facilitate production and final inspection. Typical material and process specifications should contain the following information as a minimum:

a. Scope.

b. Applicable Documents.

c. Material Requirements (Material Specifications only):

(1) Mechanical, physical, and chemical,

(2) Testing (flammability, etc.),

(3) Safety and health information,

(4) Transportation, storage and handling,

(5) Sampling plan, and

(6) Qualified Products List.

d. Processing (Process Specifications only):

(1) Process information,

(2) Process controls (cure cycle parameters, documentation of material out time, etc.),

(3) Materials,

(4) Test specimen construction and processing for quality control inspection,

(5) Personnel qualifications, and

(6) Tool proofing and control.

e. Quality Control (Material & Process Specifications):

(1) Material and process verification,

(2) Quality control and inspection records,

(3) Required tests (flammability, etc.),

(4) Inspection criteria,

(5) Verification of personnel qualifications,

(6) Environmental controls, and

(7) Nondestructive testing.

Note: Specifications should not contain terms which are subject to various degrees of interpretation such as: adequate, as necessary, as required, room temperature, periodically, etc. Any tolerances required to control the process should be clearly defined.

6. MATERIALS.

a. The FAA requires all drawings submitted for design approval to contain sufficient information or references to material specifications or other such data to clearly identify the materials and processes necessary to ensure production of like articles. When materials for non-metallic compartment interior components are produced in accordance with a proprietary process or the composition of the materials is proprietary, the production approval holder or applicant may prefer to exclude this proprietary data from the design data submitted to the FAA.

In these instances, the applicable design drawings should refer to a specification which contains this proprietary information so complete traceability to material composition is possible. These specifications will then be made available to the FAA for review and approval under an arrangement between the FAA and the production approval holder or applicant that protects the proprietary data. Under FAR sections 21.33 and 21.157 (Inspection and tests), the FAA is authorized to review such data upon request.

b. The production approval holder or applicant should have an incoming material acceptance plan. The incoming material acceptance plan should ensure the purchased non-metallic compartment interior component materials conform to the specifications identified in the approved design data.

(1) Supplier laboratory test reports showing actual test results should accompany each batch of material received for review and approval. However, the material supplier's test report alone should not be considered adequate documentation to substantiate the materials' compliance to all specification requirements. The materials' physical, chemical, and mechanical properties should be periodically tested to demonstrate conformance to engineering and manufacturing requirements, and to verify the accuracy of supplier's laboratory reports. Also, the materials' conformity to flammability requirements should be periodically demonstrated by tests as follows:

(i) Normal, Utility, Acrobatic, and Commuter Category Airplanes per FAR Part 23, Subpart D, Design and Construction, Section 23.853 Fire Protection, Compartment Interiors.

(ii) Transport Category Airplanes per FAR Part 25, Subpart D, Design and Construction, Section 25.853, Fire Protection, Compartment Interiors.

(iii) Normal Category Rotocraft per FAR Part 27, Subpart D, Design and Construction, Section 27.853, Fire Protection, Compartment Interiors.

(iv) Transport Category Rotocraft per FAR Part 29, Subpart D, Design and Construction, Section 29.853, Fire Protection, Compartment Interiors.

(2) These tests may be accomplished by the production approval holder or applicant at their production facilities or an independent laboratory approved for such testing under their QC system. The frequency of such testing may be varied once confidence in the quality of products, from a particular source, has been established by the production approval holder.

c. The production approval holder or applicant should test all materials experience has shown to be hazardous or unreliable to determine their suitability for use. This includes toxicity testing those materials that when ignited emit toxic fumes.

7. MANUFACTURING CONTROLS. The manufacture of acceptable and reliable non-metallic compartment interior components is dependent on the type and degree of process controls employed during fabrication. If all pertinent process variables are adequately controlled, there is the added assurance the parts and structures produced will be acceptable. Process procedures should clearly define the type and degree of process controls employed to ensure QC objectives have been met. Manufacturing process controls which should be a part of the QC system include, but are not limited to the following:

a. The production approval holder or applicant should develop integrated quality and production control procedures for operations that define product configuration, selection of materials, tooling and facility equipment calibration, sequence of fabrication and inspection operations, critical in-process parameters and processing tolerances, and conformity to QC standards.

b. The production approval holder or applicant should establish a program to train and qualify operators and inspectors, as appropriate. This program should measure operator performance to production standards and provide for requalification, as necessary.

c. Prior to the start of production, manufacturing processes should be qualified by demonstrating the combination of materials, equipment, procedures, and other controls making up the process are capable of producing parts having consistent material properties that conform to design requirements.

d. Once the manufacturing process has been established it should not be changed unless a comparability study and necessary testing of differences has been completed. In addition, processes should be reviewed and requalified if necessary, whenever any significant changes are made to the process such as: sources of material, equipment controls, and tool design changes. Process capability should be demonstrated by inspection and testing as necessary to determine conformity to design requirements.

e. After initial process qualification, testing for conformity to design requirements should continue on an appropriate frequency to ensure the manufacturing process,

materials, and associated tooling continue to operate in a state of control and produce conforming parts. Simulated parts or process control panels should be processed with production lots for this purpose.

f. When repairs are performed, adequate controls should be utilized to ensure the repair has not compromised the integrity of the part. These controls may require additional testing and/or simultaneous processing of process control panels.

8. NONDESTRUCTIVE TESTING.

a. The nondestructive testing (NDT) methods selected should be capable of detecting the types of defects associated with the specific part fabrication process and part configuration.

b. Visual inspection is the most widely used nondestructive inspection method. Discrepancies that can usually be observed include: discoloration, foreign matter, crazing, cracks, scratches, blisters, dents, orange peeling, pitting, air bubbles, porosity, resin rich and resin poor areas, and surface wrinkles. Reflected light is used for observing surface irregularities. Transmitted light (assuming both surfaces are accessible and the material is translucent) helps to reveal subsurface discrepancies within the specimen.

c. Other NDT methods such as: ultrasonic, radiographic, and holography should be used if visual inspection alone is inadequate to assure full conformance to the design requirements.

9. FINAL ACCEPTANCE.

a. Final acceptance procedures and quality control standards should provide added assurance the completed structure meets its functional and design requirements.

b. Final acceptance records should provide evidence the following significant production and QC activities, specifically designed to assure the quality of compartment interior components have been completed:

(1) Incoming material acceptance,

(2) In-process fabrication and assembly controls,

(3) Maintenance of tooling and facility equipment,

(4) Calibration of inspection and laboratory test equipment,

(5) Inspection acceptance of functional characteristics at detail and assembly levels,

(6) Configuration control, and

(7) Material Review Board disposition.

10. STORAGE AND HANDLING. Some compartment interior raw materials such as adhesives and resins may be subject to deterioration if not controlled under proper environmental conditions. These temperature sensitive materials should be stored at low temperatures in freezers to retard partial curing of polymer materials and extend their shelf life. Therefore, it is essential raw material transportation, handling, and storage procedures are established, followed, and subjected to periodic independent auditing to ensure continued conformity to the materials' chemical, physical, and mechanical properties.

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